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**VARIETIES OF SUGAR CANE IN PORTO RICO.**

By F. S. EARLE, Agronomist, Insular Experiment Station.

The question of sugar-cane varieties has attracted much attention for many years, and there can be no doubt of its supreme importance to the cane planter. The number of existing varieties is now very great and it is being added to each year by enthusiastic plant breeders in all parts of the sugar world. There is a voluminous literature on the subject. The planter therefore has no lack of material from which to choose but in most regions there is a serious lack of knowledge as to the adaptability of these multitudinous kinds to the requirements of local needs and conditions. A few investigators, particularly Bovell in Barbados and Harrison in Demerara, have done a noteworthy service in the laborious and careful testing of the many kinds they have produced and the recording of the results obtained with each under varying local soil and cultural conditions. This work, now continued over a long series of years, has been of inestimable benefit to the communities concerned, as it has served to very greatly increase the average yields of sugar. Unfortunately, we cannot assume that the results obtained by these careful investigators will be universally applicable. The same painstaking testing needs to be repeated, not only in each of the cane-growing countries, but in each of the principal soil and climatic districts within each country. For each variety we need to know whether it is best adapted to low, wet soils or to high and dry ones; to sandy loams or to heavy clays; whether it matures early, and is thus suitable for late spring planting, or whether it requires a long season for maturity and consequently should only be planted in the fall as "*gran cultura;*" above all we need to know its ratooning powers and how many cuttings may be expected from a given planting under any of the above conditions. Since cane is grown only for

the sugar that can be extracted from it the percentage of sucrose, the purity and the total recoverable sugar produced per acre are factors of vital importance. Unfortunately, great vigor and high tonnage are not always associated with high sucrose content and purity. In fact some investigators claim that they are antagonistic, that unusually high sucrose content is an abnormality, and that it is always accompanied by somewhat lessened vigor. Be this as it may, the fact remains that the record for highest sugar production per acre is often held by a variety with a comparatively low sucrose content. The fact that the planting of low-grade canes is sometimes most profitable is abundantly shown by the fact that in Demerara the acreage of D-625 far exceeds that of any other kind while in the Hawaiian Islands for many years the bulk of the sugar has been produced from the Yellow Caledonia, both varieties that are notoriously low in sucrose. It is by no means a simple matter to decide what policy is best to follow in this respect. It will depend on many factors. To get a given number of tons of sugar from a low grade cane requires the cutting, handling and grinding of a considerably increased tonnage—it requires more labor. The higher per cent of fiber in these canes will give more fuel for the boilers, but, on the contrary, it needs more steam to concentrate these diluted juices and more power to grind the harder fibrous cane. The policy to follow must then largely depend on the two factors of labor supply and mill capacity. Where labor is abundant and mill capacity rather in excess of cane supply, as is usually the case in Porto Rico, the policy should be to plant those kinds that will give the greatest yield of sugar per acre even if this involves the handling and milling of some extra tons of cane. In those countries on the contrary where cane can be easily grown in excess of milling capacity, and where labor is scarce and high, the policy had better be to plant those canes which give the greatest yield of sugar per ton of cane handled. The above discussion will apply in its entirety only where mills grow their own cane. Where they buy it from *colonos* on a tonnage basis, as is most usually the case, a conflict at once arises. It is the interest of the *colono* to produce the most tons possible per acre, while the mill owner wishes to insist on the planting of only those kinds yielding the richest juice. This conflict can only be adjusted by changing cane contracts so as to pay on the basis of the actual sugar content of the cane delivered. In any event we are greatly in need of much more accurate knowledge as to the probable behavior of the confusing number of varieties with

which we are confronted under each of the many and varied cultural conditions. This knowledge can only be obtained from the records of careful trials extending over a term of years. We need to know not only how each variety yields under ordinary plantation treatment on each of the principal soil areas but how it responds to special treatment—better cultivation, more fertilizer and irrigation. Another most important point to determine is that of comparative resistance or susceptibility to the various diseases and insect pests that attack cane. The failure of kinds commonly cultivated when attacked by some of these many enemies, and the search for kinds having greater resistance, has been the leading cause for the production of this multitude of new varieties.

A discussion of cane varieties will naturally fall under two quite distinct headings, the one dealing with their cultural values and characteristics, and the other with their description and classification—the one treating them from the agricultural viewpoint, the other from the botanical or taxonomic. The literature of the subject will be found much more useful in the first part of the discussion than in the second. It is really remarkable how few descriptions of cane varieties have been published that would by any possibility enable one to identify the variety. This is perhaps natural enough since the students of cane varieties have as a rule been agriculturists and not botanists. One of the principal objects of this paper is to show that cane varieties may be described, classified and keyed out and determined by the ordinary methods of descriptive botany or taxonomy. They seem to present no greater difficulties than do any numerous groups of closely related natural species.

#### CULTURAL VALUE AND CHARACTERISTICS OF CANE VARIETIES IN PORTO RICO.

The cane originally planted in Porto Rico was known as the Creole. It was a soft cane of only moderate tonnage and sugar value. About the beginning of the nineteenth century it was quite completely surplanted by the cane variously known as Otaheite, Bourbon or Caña Blanca. This gave much better yields and it came to be almost universally planted not only in Porto Rico but in the other islands of the West Indies. In fact the sugar industry of this part of the world was for many years almost exclusively based on this variety. In 1872 a disease appeared in western Porto Rico which caused heavy losses and for some years threatened the ruin of the industry in this part of the Island. A government commission was

appointed to study the disease composed of Drs. Grand-Court, Agustín Stahl and José Julián Acosta. They issued a full report in 1878 in which while admitting that they had been unable to determine the cause of the disease they strongly urged the abandonment of the Caña Blanca and the planting of the Morada, the Rayada and the Crystalina, which they found to be resistent to the malady. The cause of this epidemic is still uncertain. It was probably a combination of root disease, *Colletotrichum* red rot, and white grub, to all of which troubles the Caña Blanca is particularly susceptible. At any rate, it caused the abandonment of this variety in all the northern and western districts and its substitution by other more resistent kinds. Since the American occupation many other kinds have been imported, especially the Demerara and Barbados seedlings, and both of the Experiment Stations and the Centrals Guánica and Fajardo have actively engaged in the breeding of new seedlings. It has been impossible to accurately determine the number of varieties now existing on the Island but there is reason to believe that it is considerably in excess of 500. The proper field study of so great a mass of material is a serious undertaking. So far it has not been done in an adequate, systematic way. We know that there are many very promising kinds but we have very little knowledge as to real capability and limitations. Besides the 44 kinds described in this paper various others have from time to time been planted on a plantation scale, the selection of the present list has been largely a matter of convenience. Guánica and Fajardo are also planting considerable areas of a number of their own seedlings that have not been disseminated, and Central Mercedita has imported and is growing a number of the newer Barbados kinds that are not mentioned here. Unfortunately, except on a few of the more carefully managed places no attempt seems to have been made to keep varieties planted separately. The new varieties sent out by the Experiment Stations are found indiscriminately mixed with the other kinds. It is rare to see a car of cane that does not show a perplexing mixture of colors and kinds. This of course is most unfortunate from every point of view. It is worse than useless to send out new varieties to planters who will not at least plant them separately.

#### OTAHEITE, BOURBON OR CAÑA BLANCA.

As stated above, for seventy-five years this was practically the only cane planted in Porto Rico. It is well adapted to rich, moist but well-drained, new lands. Under these conditions it grows with

great vigor. It is a good milling cane and gives juices above the average in sugar content and purity. It matures early and so is suitable for late spring plantings. It is, however, highly susceptible to root disease and to injury from the white-grub attacks. For these reasons it ratoons very badly on old worn soils. It is also very susceptible to *Colletotrichum* red rot and unless harvested as soon as mature it is liable to serious losses on this account. These inherent weaknesses caused its abandonment in northern and western Porto Rico during the epidemic of 1872-80. It is still cultivated to some extent in the southern and eastern districts, usually under irrigation. It ratoons so badly that it is now mostly confined to those plantations that practice plowing up and planting each year. From first place it has now fallen to about fifth in total acreage. It can only be planted under the most favorable conditions, and even then its planting can not be advised since there are other equally good kinds that can be planted with less risk. It has also been badly injured by the mosaic disease. Much has been written about the running out or deterioration of this cane. Facts in support of this theory, however, seem lacking. Planted on new timber lands, the condition for which it is adapted, it still grows with its old-time vigor. In other words, it is the deterioration of the land under continued cultivation, and not the running out of the variety, that has caused its abandonment throughout the West Indies. Its root system is not adapted to the bad cultural conditions found in worn, compacted and impoverished soils.

#### RAYADA.

This seems to be the same as the Ribbon Cane of Louisiana and the Rayada of Mexico and South America. First generally planted as the result of the epidemic of 1872-80, it is now the prevailing kind in all the northern and western districts and is also commonly found in the south and east. At present it undoubtedly holds first place in total acreage. The tonnage yield is perhaps never quite so great as with Otaheite, when at its best, but the average yields are better since it is a hardy cane adapted to a wide range of soils and conditions. In richness of juice and purity it stands high, often going above 15 per cent sucrose and 90 per cent in purity under heavy mill extraction. One of its greatest advantages is its power of continued ratooning. Fields are in existence on the north coast of Porto Rico that have been in continuous production for over twenty years. Eight and ten-year ratoons are not uncommon on

good lands and with reasonably good care. The Rayada is a medium-season cane not reaching its best condition under 14 or 15 months, but it can be cut at 12 months. Being highly resistant to the red rot fungus, *Colletotrichum*, it can remain long in the field after maturity without deterioration. It suffers considerably from the moth-borer, being about the average in this respect. It is attacked by root disease and white grubs, but as shown by its ratooning power it suffers less than many other kinds. It is freely attacked by the mosaic disease, but shows a considerable degree of resistance to its effects. The stalks of diseased plants do not develop serious cankers until in advanced stages of the disease. With good cultivation and extra nitrogenous fertilizers heavily diseased fields may be made to yield three-fourths of a normal crop.

This cane has often been surpassed both in tonnage and total sugar yield per acre by some of the newer kinds, but it is by no means proven that any of these could profitably replace it under the many conditions where it succeeds. Until this proof is fully convincing it should continue to be planted in all those districts where it is now the favorite.

#### CRYSTALINA.

This cane is now second in acreage in Porto Rico, being most abundant in the southern part of the Island. It is the kind commonly grown in Cuba, where in the eastern provinces it is sometimes known as Ceniza. Under the name of White Transparent it was long the standard kind in Barbados and other of the West Indies, though there it is now largely superceded by some of the newer seedlings. It has also been known as Mont Blanc, Caledonian Queen, and by many other names. According to Noel Deerr it is the White Cheribon and originated as a bud sport from the Striped Cheribon, our Rayada. It is known as Rose Bamboo in Hawaii, but is not the cane known by that name here, which is probably the Salangore. Whatever its origin or synonamy, it is culturally so closely like Rayada that all the remarks made under that heading may be applied here. It seems to be largely chance that one is planted more commonly in the south and the other in the north side of the Island. Each planter usually has a strong preference for either one or the other but no two agree as to their cultural differences. Both are good canes and should not be hastily discarded. For comparison with the other varieties the record of yields as given by Cowgill and McConnie are given here:

COWGILL, Insular Experiment Station. Circular 8: 11, 1917. Average of 2 lots of Crystalina and 1 of White Transparent plant cane; 41.97 tons, 1st ratoon, 21.31 tons; 2nd ratoon, 9.91 tons; sucrose, 16.38 per cent; purity, 93.1 per cent.

McCONNIE, Revista de Agric., 1: 17, 1918. Under name of White Transparent average of 2 crops, 26.73 tons; sucrose, 12.2; purity, 87.8; tons sugar, 3.31; 10th in total sugar out of 25 kinds.

It may be added that in the irrigated fields of Central Aguirre, Crystalina has at various times made yields of over 80 tons per acre, which is decidedly more than has been recorded for any other variety. This shows how well this old standard kind responds to good culture. It is unfortunate that tests of other kinds were not made under the same conditions.

#### CAVANGERIE.

This cane, known as Caña Colorado and French Cane, is another kind that came into general cultivation as a result of the epidemic of 1872. It stands drought exceedingly well and will make a fair tonnage on lands so hard and dry that most other kinds fail. It is also quite resistant to root disease and so ratoons well. For these reasons it has been quite widely planted, especially by small *colonos*, notwithstanding the fact that it is notoriously low in sucrose and high in fiber, and that the mills usually discriminate against it. No statistics are available, but it seems probable that before the outbreak of the mosaic disease the total acreage of this cane equaled or exceeded that of the Crystalina. While markedly hardy in other respects it is exceedingly susceptible to this disease, and when attacked it suffers more seriously than any other kind in general cultivation. This seems to be the chief reason why this disease has caused the abandonment of cane cultivation on so many farms in the Isabela district, and at many other points in the hill lands along the north coast, and in the center of the Island. These are the districts where this red cane was so widely planted. On contracting the mosaic disease growth is soon checked, and the canes become so badly cankered as to be dry and worthless and the field has to be abandoned. It is clearly unadvisable to plant this cane in districts where this disease is prevalent. Whether it should be planted at all, even in districts free from mosaic, is perhaps an open question. The mills certainly all oppose it, since it is a hard cane to grind and gives an unsatisfactory yield of sugar per ton of cane. Comparative statistics of yields are scanty, but as reported in Insular Station Circular No. 8, it stood third in total tonnage for three crops being only sur-

passed by the equally poor D-116 and D-625 and it was fifth in total sugar per acre out of a list of twenty-five kinds. This record is good enough to at least call for further study in a country like Porto Rico where mill capacity is in excess of cane supply.

#### YELLOW CALEDONIA.

This cane came to Porto Rico from Hawaii some years ago. Its planting has gradually increased until it now probably holds fourth place in total acreage and its planting is being extended more rapidly than that of any other kind. Its popularity is due to its resistance of root disease and its ability to grow and give good yields on worn, compact, wet lands where Rayada and other better kinds no longer yield nor ratoon satisfactorily. It seems to give down rather quickly when attacked by the white grub and it is injured decidedly more by the mosaic disease than the Rayada. If its further planting is not checked by this last factor, it seems destined to replace the Rayada and Cristalina, at least on the heavy compact wet lands of the north coast. Wherever it is found on such lands it is growing so much better than the Rayada as to immediately attract attention. Its planting has been discouraged by the mills since it is comparatively low in sucrose and high in fiber, but this will not prevent its continued and increased planting unless it is checked by its susceptibility to the mosaic disease. It requires plenty of moisture and should not be planted on high dry soils. Published records of performance are few and by no means do justice to the real vigor and productiveness of this cane as seen in hundreds of fields in all parts of the Island.

COWGILL, Annual Report, 23, 1917. Was fifth in total tonnage as plant cane and 1st ratoons out of a list of 9 kinds. Plant cane, 28.75 tons; 1st ratoons, 12.25. Average sucrose, 15.5 per cent; purity, 86.51 per cent.

COWGILL, Insular Experiment Station Circular 8: 11, 1917. Weight of plant cane not given. As first ratoon only took 8th place out of a list of 25 kinds. 1st ratoons, 29.35 tons; 2nd ratoon, 17.45 tons; sucrose, 14.85 per cent; purity, 85.9 per cent.

MCCONNIE, Revista de Agric., 1: 17, 1918. 8th in total sugar out of 25 kinds. Average of 3 crops, 32.31 tons; sucrose, 10.8 per cent; purity, 81.7 per cent; tons of sugar, 3.41.

#### THE DEMERARA SEEDLINGS.

A number of the seedlings grown in Demerara by Mr. Harrison have been imported at various times and the following five have been more or less extended on a plantation scale. No statistics as to acre-

age are available. These kinds are distinguished by the initial D. D-74 and D-95, the well-known kinds so much planted in Louisiana, were also grown at one time, but seem to have been dropped. This was doubtless a mistake, so far at least as D-74 is concerned, for this cane matures so early that it should be very useful to plant in the late spring and also to have a few fields of earlier planting on which to begin the grinding. In early December it often shows fully 3 per cent more sucrose than Rayada or Crystalina at this same date. At ten months it will be sweeter and better to grind than Crystalina at twelve months. This point in the hands of a skilled planter would make it very valuable although it would not be suitable for the main planting under Porto Rican conditions. It yields and ratoons about as well as Rayada or Crystalina.

#### D-109.

This cane has been more or less planted for a number of years. It is a good general-purpose cane, doing well on a variety of soils. It seems particularly well adapted to the red shale clay hills. It ratoons well, showing considerable resistance to root disease. In all these respects as well as in sucrose content and purity it is just about equal to Rayada and Crystalina. It is, however, more susceptible to injury from mosaic disease, so there seems to be no particular reason for extending its planting.

It never took very high rank in Demerara, being twelfth in total sugar production out of a list of 72 kinds. Jour. British Guiana 11:11, 1918. It does not figure in the Barbados reports, but has been rather a favorite at some of the smaller islands, particularly at St. Kitts and Nevis, where it has held first place in tonnage. Its record here is as follows:

COWGILL, Insular Experiment Station Cir. 8:11, 1917. Plant cane, 36.57 tons; ratoons, 24.55 tons; 2nd ratoons, 17.60 tons; sucrose, 14.98 per cent, purity, 87 per cent.

McCONNIE, Revista de Agric., 1:16, 1918. 19th in total sugar out of 25 kinds.

Average yield 3 years, 23.21 tons; sucrose, 11.4 per cent; purity, 85.3 per cent; tons of sugar, 2.97.

#### D-117.

This kind seems to have attracted very little attention in the other islands of the West Indies, but here it is one of the most valuable we have. It grows well on a variety of soils, but seems to be particularly adapted to planting as long crop or "*gran cultura*" in the irrigated lands of the south coast, where it is quite largely

planted, especially on the Guánica estates. It ratoons well thus showing its resistance to root disease. Fortunately, it is, if anything, more resistant to mosaic than the Rayada. It is a rather late maturing cane, but when well ripened the sucrose and purity are good. Under most conditions it will outyield Rayada and Crystalina. Its much wider planting can be safely encouraged. Its published record follows:

MAY, Federal Station, Bull. 9: 10, 1919. At Guánica in 1908, tons, 56.45; sucrose, 14.4 per cent; purity, 83.2 per cent. At Monserrate in 1908, tons, 64.60; sucrose, 15.0 per cent; purity, 85.0 per cent.

COWGILL, Annual Report, 3: 9, 1915, on hill, hand plant, 19.9 tons. 1st ratoons, 34 tons; 2nd ratoons, 13.01 tons; sucrose, 14.10 per cent; purity, 81.8 per cent.

Annual Report, 23, 1917. Plant 30 tons; 1st ratoon, 20.90 tons; sucrose, 13.6 per cent; purity, 83.4 per cent and 89.48 per cent.

*Ibed*, p. 25. Plant, 20.55 tons; sucrose, 19.94 per cent; purity, 92.40 per cent.

Annual Report, 5: 26, 1917. Cut at 11 months; 1st in tonnage in a list of 9. Plant cane, 30 tons; sucrose, 13.6 per cent; purity, 83.4 per cent.

Insular Station, Circ. 7: 11, 1917. Stands 2nd in tonnage out of a list of 25. Plant, 57.53 tons; 1st ratoon, 25.76 tons; 2nd ratoon, 16.30 tons; sucrose, 15.92; purity, 90.0 per cent.

McCONNIE, Revista de Agric., 1: 15, 1918. 13th in total sugar out of 25 kinds. Average of 3 years, 29 tons; sucrose, 11 per cent; purity, 82.9 per cent; total sugar, 3.17 tons.

#### D-433.

This is a favorite cane at Fajardo on the east coast where, it is being quite largely planted. It seems particularly well adapted to low, wet lands, where it makes a very heavy tonnage. It also grows very well in the red clay hills. It seems to be resistant to root disease. It has been but little noticed in the literature, but it is reported in Jour. Brit. Guiana, 11: 11, 1918, as highest in total sugar yield out of a list of 72 kinds. Here its only published record is the following:

McCONNIE, Revista de Agric., 1: 15, 1918. 6th in total sugar out of 25 kinds. Average tonnage for 3 years, 31.13; sucrose, 11.5 per cent; purity, 83.2 per cent; total sugar, 3.53 tons.

#### D-448.

This cane is also thought highly of at Fajardo where it is considerably planted, and where it is giving good yields. It is seldom mentioned in the literature and its one published record here does not do it justice.

McCONNIE, Revista de Agric., 1: 16, 1918. 24th in total sugar out of 25 kinds.  
Average of 2 crops; 16.89 tons; sucrose, 11 per cent; purity, 83.3 per cent; total sugar, 1.74 tons.

### D-625.

This is another vigorous productive cane, but having low sucrose and purity. It has been considerably planted, especially on the east coast, but it is mostly found mixed in with other canes as the mills refuse to receive it if planted in pure cultures. A cane has also been planted in Porto Rico under the name of D-116. Some observers claim that it, as grown here, is identical with D-625, while others hold them to be distinct. The writer has not seen any cane under the name of D-116, so cannot attempt to decide the matter. At least they are similar in cultural characteristics. Whether or not it is ever desirable to plant low-grade canes of heavy tonnage has been discussed in another place. Notwithstanding its low sucrose content it has steadily gained ground in the country of its origin until it occupies (crop of 1916) half of the acreage of the colony. It is not always highest in tonnage and only stands fourth in total sugar per acre. Jour. Brit. Guiana 11:155, 1918. In the smaller islands it often takes first place in tonnage. Its record here follows:

COWGILL, Insular Station Circ. 8: 11, 1917. Plant, 56.27; 1st ratoon, 44.46 tons; 2nd ratoon, 28.52 tons; sucrose, 10.65 per cent; purity, 71.1 per cent. D-116 here treated as district gave the following: Plant, 63.60; 1st ratoon, 60.70; 2nd ratoon, 28.52 tons; sucrose, 10.65 per cent; purity, 71.1 per cent. D-116 1st place in total tonnage and also as plant cane, out of a list of 25 kinds. D-615 was 2nd in total tonnage, but fell to 3rd place in tonnage as plant cane, being surpassed by D-117.

McCONNIE, Revista de Agric., 1: 17, 1918, as D-116. 2nd in total sugar out of 25 kinds. Average of 2 crops, 38.48 tons; sucrose, 10.3 per cent; purity, 78.7 per cent; total sugar, 3.99 tons.

### THE BARBADOS SEEDLINGS.

Up to 1916 (Barbados Rept. 1916-17) a total of 73,469 seedlings had been grown in Barbados by Mr. John R. Bovell and his associates. Of this great number, 7,078 had been selected and replanted for further study. Of these, 3,222 were still in cultivation during that year and 738 were weighed and analyzed. This is one of the greatest tasks in plant breeding that has been accomplished anywhere in the world. It has been of incalculable value to the sugar industry of that island since the best of these new kinds are now almost exclusively planted and are giving sugar yields almost twice

as great as the Crystalina, which under the name of White Transparent was the kind formerly planted. Replying to questions as to the parentage of some of the varieties discussed in this paper in a letter dated January 28, 1919, Mr. Bovell writes interestingly as follows:

"I beg to enclose herewith a list of the canes you mention with a statement against each showing, where known, the parentage. When I first commenced to grow seedling sugar canes in Barbados, in addition to sowing seeds in boxes taken from sugar cane the names of which I know, I used also to go about the fields and where I found seeds germinating I would transplant the young plants into pots, and so in such instances I would be unable to record the parentages. With regard to the varieties of the sugar canes which you mention as being cultivated in Porto Rico now, I may mention that in Barbados we are practically only cultivating the B-6450, nearly all the others having been discarded. At the present time we have canes that are far superior to the B-6450 even, not only in tonnage and sucrose content, but also in resistance to various diseases. The seedling sugar canes Ba-6032 and BH-10(12) which are now being generally cultivated in the plantations are, I am glad to tell you, giving splendid results here. The BH-10(12) is not only a good germinator, but it is a cane that gives an exceptionally good tonnage and the sucrose content and quotient of purity are high. Last year at one factory that has an eight-roller mill it took only seven tons to make a ton (2,240) of sugar."

Besides the 12 kinds discussed in this paper, all but one of which, it seems, are now discarded there, various others of the Barbados seedlings have been introduced and more or less planted. None of them, however, seems to have gained much foothold. Seed canes of the two kinds mentioned by Mr. Bovell have recently been imported by Central Guánica and it will be of great interest to watch their behavior here.

#### B-109.—PARENTAGE UNKNOWN.

This is a good vigorous cane of about the same cultural value as the Crystalina, often being a little better in tonnage, especially as ratoons, but not quite so high in sucrose and purity. Cowgill recommends it for the red shale hills. It is fairly resistant to root disease, as shown by its good ratooning powers, but its behavior in regard to the mosaic disease has not been determined. It is doubtful if it has any special advantage over other kinds, but it should not be discarded without further trial. It has never won a place in Barbados, but has been more or less planted in the smaller islands, where its record has usually been a medium one. In one three-year test it took second place in Antigua. Its published record here follows:

COWGILL, Insular Station Circ. 8: 11, 1917. Plant, 34.59 tons; 1st ratoon, 24.25; 2nd ratoon, 14.70; sucrose, 15.61 per cent; purity, 89.8, standing 12th in total tonnage out of 25 plots.

Annual Report, 25, 1917. Plant, 28.70 tons; sucrose, 18.20; purity, 88.80, taking 1st tonnage out of 6 kinds, Rayada in same test making 24.10 tons and B-3412, 26.25 tons.

McCONNIE, Revista de Agric., 1: 16, 1918. 12th in total sugar out of 25 kinds. Average for 2 years, 23.37 tons; sucrose, 11.3 per cent; purity, 84.7 per cent; total sugar, 3.24 tons.

#### B-208—PARENTAGE UNKNOWN.

When all conditions are favorable this is a splendid cane. It was the first of the Barbados seedlings to attract wide attention. It has been carried all over the world and has probably been more widely planted than any of the others. Like the Otaheite, it requires a deep mellow, moist but well-drained soil. In such situations and with a regular water supply it gives good tonnage and juices among the highest known in sucrose and purity. It matures early, so it can be used for late spring planting. It is not suited to hard dry soils and is easily injured by drouth, not recovering well when rains do come. Under favorable conditions it ratoons fairly well. It is, however, exceedingly susceptible to mosaic disease and is very badly injured by it. At one time it was the leading cane in Barbados and it has been largely planted in Jamaica and the smaller islands. Its record has been very uneven, sometimes standing well toward the head of the list as a sugar producer and at others falling comparatively low. This uncertainty of performance has caused it to lose ground in all quarters and it is less planted than it was six or eight years ago. It certainly would be an unsafe cane to plant for the main crop, but in the hands of a skillful planter on suitable lands it would be profitable for late spring planting, especially in irrigated districts where it need not suffer from drouth. Its local record follows:

COWGILL, Annual Report 3: 9, 1915. In red shale hills. Plant, 38.4 tons; 1st ratoon, 28.7; 2nd ratoon, 15.05; sucrose, 17.13; purity, 91.7.

Annual Report 25, 1917. Cut at 11 months. Plant, 25.30 tons; sucrose, 18.1; purity, 92.34; 6th in tonnage out of 9, but 1st in sucrose and purity.

Circular 8: 11, 1917. Plant, 30.46 tons; 1st ratoon, 15.30 tons; 2nd ratoon, 24.37 tons; sucrose, 14.90; purity, 91.5

McCONNIE, Revista de Agric., 1: 15, 1918. 11th in total sugar out of 25 kinds.

Average of 3 crops, 22.61 tons; sucrose, 13.2; purity, 89.7; total sugar, 2.97 tons.

## B-347—PARENTAGE UNKNOWN.

(Also known as B-306.)

This is another good average cane, but apparently without any special characteristics that would warrant its continued planting. It is quite resistant to root disease as shown by its unusually good ratooning ability. Its behavior as regards the mosaic disease has not been determined. The foliage seems particularly subject to some of the leaf-spot diseases. In 1912 it was reported as being much planted in Trinidad, but as early as 1906 it was discarded in Jamaica as not worthy of further trial. It seems to have attracted but little attention in the other islands. Its record here is fragmentary. Cowgill, 5th Ann. Rept. 23, 1917, reports a mill run on a lot of 16 ears which gave 1 per cent more sucrose and 3 per cent higher purity than the mill run for that day.

COWGILL, Circular 8: 12, 1917. Plant cane, 24.42 tons; sucrose and purity not given.

McCONNIE, Revista de Agric., 1:16, 1918. 16th in total sugar out of 25 kinds.

Average of 3 crops, 22.6 tons; sucrose, 11.8 per cent; purity, 84.3 per cent; tons of sugar, 2.58.

## B-376—PARENTAGE UNKNOWN.

This cane is so much like Crystalina in both botanical and cultural characters that it is difficult to find any technical point by which to distinguish them. Clearly it must have been a chance seedling from the Crystalina. It is, if any difference, an even better ratooner than Crystalina, but does not resist the mosaic disease quite so well. It has a long record in the Barbados reports, being formerly largely planted there and frequently taking first or second place in sugar yield, especially as old ratoons on red lands. In St. Kitts and Nevis as late as 1916 it was reported as becoming popular on account of heavy tonnage. In sucrose and purity it about equals Crystalina and has quite uniformly exceeded it in tonnage both here and in the other islands. Considering it simply as an improved Crystalina, its further planting seems decidedly advisable. Its published record here follows:

COWGILL, Insular Station, Cire. 8: 11, 1917. Plant, 39.37 tons; 1st ratoon, 30:35 tons; 2nd ratoon, 14.40 tons; sucrose, 16.68 per cent; purity, 91.4 per cent.

McCONNIE, Revista de Agric., 1: 16, 1918. 11th in total sugar out of 25 kinds.

Average of 3 crops, 27.39 tons; sucrose, 12.1 per cent; purity, 87.5 per cent; tons sugar, 3.29.

## B-1809—PARENTAGE UNKNOWN.

This is another very good cane, but with nothing in its record to specifically recommend it. It grows well and ratoons well, but it is rather susceptible to the mosaic disease. Sucrose and purity are good. It has figured but little in reports from the other islands. It is not sufficiently tested here for a final judgment.

COWGILL, Annual Report, 23, 1917. Plant, 23.70 tons; 1st ratoon, 17.35 tons; sucrose, 16.5 per cent; purity, 87.81 per cent.

Annual Report, 5:24, 1917. 4th in combined tonnage out of 20 kinds. Combined plant and 1st ratoon, 46.50 tons; sucrose, 16.43 per cent; purity, 91.13 per cent.

Plant cane cut at 11 months. 7th out of 9 kinds. Plant, 23.70 tons; sucrose, 14.7 per cent; purity, 82.5 per cent.

## B-3405—A SEEDLING OF D-74.

This is another good cane that has not been sufficiently tested here to make a final judgment possible. As second ratoons it is now (March, 1919) making the best showing of any of the kinds in the variety plots at the Insular Station. It evidently is highly resistant to root disease, but its susceptibility to mosaic has not been determined. In the Barbados reports it for many years took a high place as a cane for red lands, especially ratoons, but always took a much lower place when grown on black lands. It certainly should be given a wider trial here, especially as a cane for upland planting. It gives promise of succeeding on those lands where Cavangerie is now so widely planted and it is decidedly a better cane.

COWGILL, Annual Rept. 5:24, 1917. 4th in total tonnage in a lot of 20 kinds. Combined plant and 1st ratoon, 54.90 tons; sucrose, 16.17 per cent; purity, 90.61 per cent.

McCONNIE, Revista de Agric., 1:16, 1918. 20th in total sugar out of 25 kinds. Average of 3 crops, 20.43 tons; 12.3 per cent sucrose; purity, 85.2 per cent; total sugar, 2.49 tons.

## B-3412—SEEDLING OF D-74.

(Also known in Porto Rico as Sealey's Seedling.)

This cane is planted quite extensively on hill lands especially by Gentrals Guánica and Fajardo. On low lands it gives heavy tonnage, but it ripens so slowly that it is usually poor in sucrose and purity. It is a long-season cane and should always be planted in the fall as *gran cultura*. While quite resistant to root disease and ratooning well, it is very susceptible to mosaic disease and should

not be planted where this is prevalent. It is never a very sweet cane, but becomes fairly good when fully mature. Its slender diameter is objected to by some, but it suckers so freely as to put it in the first rank as regards tonnage. It is not a general-purpose cane, but can be used to advantage by those who understand it. It long held a prominent place in Barbados, especially in the red lands, where it frequently headed the list in total sugar production. Seeley's Seedling is considered distinct in Barbados, but the cane grown here under that name cannot be distinguished from B-3412. Its local record follows:

**COWGILL**, Insular Experiment Station Circ. 8: 11, 1917 (as Seeley's Seedling).

Plant, 45.85 tons; 1st ratoon, 36.35 tons; 2nd ratoon, 25.95 tons; sucrose, 14.85 per cent; purity, 89.1 per cent.

**McCONNIE**, Revista de Agric., 1: 15, 1918. 3rd in total sugar out of 25 kinds.

Average of 3 crops, 33.25 tons; sucrose, 12.1 per cent; purity, 84.6 per cent; total sugar, 3.96 tons.

*Ibed.*, 17 (as Seeley's Seedling). 17th out of 25 kinds. Average of 3 crops, 26.21 tons; sucrose, 10.80 per cent; purity, 84 per cent; total sugar, 2.81 tons.

#### B-3922—SEEDLING OF B-647.

This has been one of the favorite canes at Central Guánica, where under irrigation it has given very satisfactory yields. In other parts of the Island it has not attracted much attention. In both the Mayagüez and Río Piedras experimental plots it is only a fair ratooner. Unfortunately, it is so seriously injured by the mosaic disease that its cultivation will have to be abandoned where that prevails. It is a good milling cane with at least average sucrose and purity. At one time it was largely planted in Barbados, where it frequently took first place as a sugar producer on red lands both as plant and ratoons. It never did so well in the black-land trials. It seems to be another cane only well adapted to certain conditions and it should only be planted by those who understand its capabilities. Its only published record in Porto Rico follows:

**McCONNIE**, Revista de Agric., 1: 16, 1918. 23 in total sugar out of 25 kinds.

Average of 2 crops, 16.63 tons; sucrose, 12.7 per cent; purity, 89.1 per cent; tons of sugar, 2.10.

#### B-4596—SEEDLING OF B-521.

This cane has attracted attention on account of supposed immunity to the mosaic disease. This, however, has not been substantiated by the immunity experiment at Santa Rita, where this kind

has fallen below Rayada in resistance. It is a strong growing cane, especially on heavy moist lands, and it is a good ratooner, but it is low in sucrose and purity and seems to have nothing to recommend it for general planting. Its record in the other islands is only ordinary; though it has taken first place in Antigua out of a test of 41 kinds. Its record here follows:

COWGILL, Annual Rept. 25, 1917. Lowest in lot of 9 kinds. Plant, 20.80 tons; 1st ratoon, 12.40 tons; sucrose, 12.80 per cent; purity, 81.30 per cent.

Circular 8: 11, 1917. 5th out of 25 kinds. Plant, 51.93 tons; 1st ratoon, 34.87 tons; 2nd ratoon, 21.70 tons; sucrose, 12.73 per cent; purity, 84.2 per cent.

McCONNIE, Revista de Agric., 1: 16, 1918. 9th in total sugar out of 25 kinds.

Average of 2 crops, 30.52 tons. Sucrose, 11.3 per cent; purity, 84.4 per cent; tons sugar, 3.37.

#### B-6292—SEEDLING OF T-24.

A slender but vigorous and productive cane with good sucrose and purity, but it has nowhere attracted any very serious attention. It seems best adapted to heavy black lands. It ratoons fairly well, but is more injured by the mosaic disease than the Rayada. It is seldom mentioned in the literature from the other islands, but here its record is decidedly above the average and it is well worthy of further trial except in locations infected with mosaic disease.

COWGILL, Annual Rept. 23, 1917. 2nd in tonnage out of 9 kinds. Plant, 28.85 tons; 1st ratoon, 17.95 tons; sucrose, 14.65 per cent; purity, 85.78 per cent.

COWGILL, Annual Report, 5: 24. 2nd place in combined tonnage out of 20 kinds. Plant and 1st ratoon, 62.70 tons; sucrose, 15.97 per cent; purity, 91.37 per cent.

COWGILL, *ibid* : 25. 3d place in list of 9 kinds cut at 11 months. Plant, 28.85 tons; sucrose, 12.3 per cent; purity, 80.9 per cent.

#### B-6450—SEEDLING OF T-24.

As shown by Mr. Bovell's letter printed on another page, this is the only one of the Barbados seedlings mentioned in this paper that is still cultivated to any extent in that island. For a number of years it held first place there and was very widely planted, but now it is being superceded by even better kinds. It seems particularly well adapted to black lands though it has taken first place on both red and black lands in Barbados, showing it to be adapted to a fairly wide range of conditions. It is a good milling cane, with

better than the average sucrose and purity. It ratoons well and is fortunately more resistant to mosaic disease than Rayada, being equal to D 117 in this respect. It is safe to urge the wider planting of these two kinds. Its only Porto Rican record is—

McCONNIE, Revista de Agric., 1: 15, 1918. 7th in total sugar out of 25 kinds.

Average of 3 crops, 29.62 tons; sucrose, 11.8 per cent; purity, 85.8; total sugar, 3.48 tons.

#### THE PORTO RICAN SEEDLINGS.

The first two hundred numbers put out under the initials P. R. were bred at the Federal Station at Mayagüez. On the establishment of the Sugar Station, now the Insular Experiment Station at Río Piedras, the work of growing cane seedlings at Mayagüez was abandoned. It has since been resumed there, the later kinds being numbered under the initials M. P. R. Of the first series none seem to have established themselves in general cultivation, though a few are still found in experimental collections. The kinds bred at the Insular Station at Río Piedras have been given the initials P. R. with numbers above 200. The numbers used now run above 500 and the kinds selected from the last two years' seed beds have not yet received permanent numbers. Seed cane of 15 of the earlier of these seedlings has been sent out quite widely to plantations in all parts of the Island. So far none of them have come into general cultivation, and unfortunately in most cases they have not been kept separate from the other plantation canes so no very positive results can be expected from this distribution. It seems unwise to distribute new kinds promiscuously. The better policy would be to keep them in the hands of a few interested parties for testing under diverse conditions until they can be specifically recommended as markedly better than existing kinds at least for special purposes. These are all good canes. Doubtless in certain cases each of them has given better results than the Rayada or Cristalina. Their botanical description will be found in the second part of this paper, but it seems unwise to attempt to discuss their cultural characteristics until more is really known regarding them. In passing it may be observed that P. R.-292 seems one of the most promising of the lot especially as to ratooning power, while P. R.-210 is deficient in this respect. This kind, however, and P. R.-260 are more resistant to the mosaic disease than is the Rayada. No performance records of these kinds have been published.

### THE GUÁNICA SEEEDLINGS.

For the past ten or twelve years the Central Guánica has each year grown a large number of seedling canes and over a thousand of these have been selected for a further planting and study. These canes are numbered under the initials G. C. A considerable number of them are now being planted on a large scale on the various Guánica estates and are giving fine results. A few have been more or less distributed, but only four are included in the descriptive part of this paper. Of these G. C.-493 and G. C.-701 are being planted on a large plantation scale. Both are good canes, but the former suffers severely from attacks of mosaic disease while G. C.-701 is fully as resistant as Rayada or perhaps even a little better in this respect. G. C.-1480 and G. C.-1486 have so far only been planted on an experimental scale, but, both at Mayagüez and at Santa Rita, they show unusually good resistance to the mosaic disease, being only surpassed in this respect by the Java canes. Their ratooning power is good, and as shown by the plots at Mayagüez they are unusually well adapted to heavy compact, wet soils. They are well worthy of extended trial for such locations. Other G. C. canes showing great resistance to mosaic are numbers 888, 1180, 1313, 1513, 1519, 1521, 1522 and 1545.

### THE FAJARDO SEEIDLINGS.

Central Fajardo has also grown a large number of seedlings and has selected and is testing several hundred of them. Some of them are being largely planted on a field scale at Fajardo, but they have not been disseminated and so are not included in this paper.

### THE IMMUNE JAPANESE CANE KAVANGIRE.

In a recent paper<sup>1</sup> the writer has called attention to the absolute immunity of this variety to the mosaic disease. The variety plots at the Federal Station at Mayagüez where this kind was first seen have now been cut for some weeks and a recent inspection of the ratoons shows that it is also resistant to root disease in a very marked degree. The stand is perfect and the ratoons are growing much more vigorously than any of the other 44 kinds in these plots. From what has been seen of it here and with its splendid record in the Argentine

<sup>1</sup> An Immune Variety of Sugar Cane. This paper was published in Spanish in the daily press of San Juan, but an abstract in English prepared by Dr. C. O. Townsend appeared in *Science*.

it seems certain that it will out-yield and out-ratoon any of the kinds now in general cultivation. On the high, dry uplands it should replace Cavengerie, and its record at Mayagüez shows it equally well adapted to the heavy, compact, low lands where the Yellow Caledonia is now gaining so rapidly in popularity. It is a long-season cane and slow in maturing. It should therefore be planted in the fall as *gran cultura*. When fully matured it will average at least as high in sucrose and purity as the Caledonia and decidedly better than the Cavengerie. The finding of this cane at this time seems to promise much for the future of the sugar industry in Porto Rico. Its slender diameter will at first be unpopular but after all it is total sugar per acre that interests us and not the diameter of the cane.

#### THE JAVA SEEDLINGS.

When the Kavangire was brought from the Argentine by the Mayagüez Station, the Java seedlings Nos. 56, 228 and 234 were also introduced from the same source. These are all slender canes, clearly showing the North Indian type of the Chunnee variety which has been used as the pollinating parent in so many of the Java crosses. While in no sense immune to the mosaic disease like the Kavangire, they are highly resistant to its effects. In 56 and 234 particularly growth does not seem to be at all checked and the presence of the disease is only indicated by hardly noticeable discolorations of the leaves. These kinds are ratooning strongly in the Mayagüez plots indicating high resistance to root disease. Nos. 36 and 234 are two of the Java kinds now being almost exclusively planted in the Argentine where they are giving very much better results than the Rayada which was formerly the standard cane. They do not give quite such heavy tonnage as the Kavangire, but they are better in sucrose and purity and they mature earlier thus escaping injury from frost. From the description of number 36 it seems to be the same cane we have here under the No. 56. While the experience with these canes in Porto Rico is still limited to the experimental plots at the Mayagüez Station and the Guánica experimental fields at Santa Rita they are exceedingly promising and are worthy of much more extended trial, especially since their resistance to the mosaic disease is so marked that its presence can be practically disregarded. Their slender diameter will at first tend to make them unpopular with most growers.

DESCRIPTIONS OF SOME VARIETIES OF SUGAR CANE NOW GROWN  
IN PORTO RICO.

## TAXONOMY OF CANE VARIETIES.

There are many published descriptions of cane varieties, but for the most part they are too brief and fragmentary to make them intelligibly comparable or of practical use in determining the kinds encountered. Cowgill<sup>1</sup> has published full descriptions of part of the kinds discussed in this paper. A part of the following has been transcribed from the data furnished from his article, but for the most part it represents direct field studies. The characters of the inflorescence have not been considered. These would doubtless furnish many good points for distinguishing varieties, but in some years many of the kinds do not flower here, and when they do it is for only a short period. To be serviceable a classification should be based on characters that are always observable. In describing a variety data should be given on all of the following points: 1st, general habit, whether growing strongly erect or soon declined, or recumbent with a word as to comparative vigor; 2d, the stalk; whether thick or slender in diameter, numerous or few in the hill, color, and amount and character of bloom; 3d, under the internodes give comparative length, shape, direction, whether straight or staggard and the presence or absence of a furrow above the bud and its characters if present; 4th, the nodes furnish important characters. The first element is the limiting ring which divides the node from the internode. It may be broad or narrow, elevated or sunken, concolorous or differently colored from the internode. Below this come the root band showing the rudimentary roots. Both these elements are really a part of the internode above. Next comes the bud, which requires a separate heading, and then the leaf scar. In a few varieties this is conspicuously ciliate, but it is usually glabrous. It may be long or short and may project equally on all sides or be appressed closely behind—on the side opposite the bud. Still below this is the glaucous band, which is usually quite conspicuous but may be obscured by blending with the bloom of the internode. 5th, are the buds which give striking and fairly constant characters, but it must always be remembered that those change with age and condition of development. These may be large or small; longer than broad, either oval or ovate and sharp pointed or obtuse; they may be triangular or subtriangular with the base rounded and about as broad

<sup>1</sup> See bibliography.

as long; or they may be orbicular or hemispheric. The point may be closely appressed to the stalk or prominently elevated. They may remain long dormant or may soon partially develop on the stalk. The margin may be wide or narrow, uniform or shouldered. The base or apex or both may be bearded or the entire bud be nearly glabrate. Other good characters could be obtained from the shape and texture of the dissected bud scales, and this would be necessary in handling a large number of kinds. 6th. The leaf sheath yields useful characters. One of the most obvious is the presence or comparative absence of a vestiture of stiff hairs on the back. The shape of the shoulders or auricles should be noted and whether one or both has a pointed lobe, though this is a variable character. The throat at the top of the sheath where it joins the leaf usually has a vestiture of long hairs. The ligule, the hard membrane that fits against the stalks at the base of the leaf, may be long or short, uniform in width or with the center elevated or depressed and the edge may be even or conspicuously fimbriate. On the back where the leaf joins the sheath is a discolored area, or rather two triangular areas, that may or may not reach the midrib and coalesce, which may be called the collar. It may be dark brown or pallid in color and either glaucous or lannate. 7th. The leaves also give good characters. Their abundance, position, color, width and general shape should be noted and especially the character of the serrations on the margin and whether these reach the base and whether or not the margin at the base is ciliate. With careful notes on these points it will be possible to determine the varieties quite accurately by the following key:

The nomenclature and synonymy of the older varieties is almost hopelessly involved. No two authors fully agree. It can never be satisfactorily straightened out without a first-hand study of authentic material on some such basis as the above.

#### KEY TO THE VARIETIES.

1. Stalks conspicuously striped, green or yellow and red-----	Rayada
Stalks reddish or brownish red or purple-----	2
Stalks at first green becoming tinted with red, pink, or violet when exposed-----	6
Stalks at first green then yellowish with no tint of red-----	26
2. Leaf sheaths with faint longitudinal stripes, stalks often with occasional faint blackish stripes-----	Cavengerie
Leaf sheaths and stalks not striped-----	3

3. Stalks medium to large diameter .....	4
Stalks slender, numerous .....	5
4. Buds ovate or oval, apex bearded .....	D-109
Buds broader than long, glabrate .....	D-448
5. Buds broadly oval, margin uniform. Stalk without heavy bloom .....	Java 53
Buds obovate the margin shouldered above. Stalks with heavy bloom .....	Java 228
6. Leaf scar conspicuously ciliolate .....	B-3922
Leaf scar glabrous .....	7
7. Leaf sheath glabrate, the vestiture confined to the median line .....	8
Leaf sheath with effused vestiture of stiff hairs .....	12
8. Cane very slender, buds small, orbicule .....	Java 234
Cane of medium to large diameter .....	9
9. Buds with margin conspicuously shouldered or lobed .....	10
Buds with margin of uniform width .....	11
10. Collar lannate, reaching the midrib .....	Crystallina
Collar glaucous, not reaching the midrib .....	B-376
11. Internodes long, cylindrical, the surface marked by checks and lines .....	Yellow Caledonia
Internodes short, tumid, not marked by checks and lines .....	P. R.-318
12. Buds longer than broad, usually ovate and pointed .....	13
Buds as broad as long, subtriangular or orbicular .....	18
13. Vestiture of leaf sheath soon deciduous, becoming glabrate .....	P. R.-230
Vestiture of leaf sheath persistent .....	14
14. Buds closely appressed, not developing in the standing stalks .....	15
Buds soon developed and prominently exserted .....	16
15. Margin of bud narrow, uniform .....	B-347
Margin of bud broad, shouldered .....	B-4593
16. Stalk medium to large in diameter .....	B-3405
Stalk rather slender .....	17
17. Ligule short .....	B-3412
Ligule long .....	B-6292
18. Buds triangular or subtriangular, pointed .....	19
Buds semi-orbicular, obtuse .....	23
19. Leaf sheath with scanty deciduous vestiture, soon glabrate .....	P. R.-207
Leaf sheaths with persistent vestiture .....	20
20. Leaf scar about equal on all sides, not appressed behind .....	21
Leaf scar appressed behind .....	22
21. Nodes not constricted, limiting ring poorly defined .....	P. R.-271
Nodes constricted above the bud, limiting ring prominent .....	P. R.-292
22. Internodes long, subcylindrical, quite glaucous .....	G. C.-1480
Internodes tumid, inequilateral, not conspicuously glaucous .....	G. C.-1486
23. Nodes conspicuously constricted below the bud .....	P. R.-303
Nodes scarcely constricted .....	24
24. Stalks glaucous with heavy bloom .....	D-433
Stalks glabrous, not glaucous .....	25
25. Buds large, margin shouldered .....	P. R.-209
Buds small, margin uniform .....	P. R.-270
26. Leaf scar heavily ciliolate .....	G. C.-701
Leaf scar glabrous .....	27

27. Leaf sheath glabrate, or with vestiture confined to median line	28
Leaf sheath with effused vestiture	30
28. Buds oval, narrowed below, stalks very slender	Kavangire
Buds triangular, margin narrow, uniform	B-109
Buds hemispheric	29
29. Leaves erect except extreme tip, broad	P. R.-202
Leaves declined, narrow	G. C.-493
30. Buds oval or ovate, longer than broad	31
Buds triangular or subtriangular	34
Buds hemispheric	38
31. Internodes with furrow very slight or none	32
Internodes with furrow well marked	33
32. Nodes oblique, root band broad, glaucous band conspicuous	P. R.-317
Nodes not oblique, root band medium, glaucous band poorly defined	P. R.-219
33. Stalk glaucous with a heavy bloom	P. R.-260
Stalk glabrous, not glaucous except the glaucous band	Otaheite
34. Limiting ring broad, reddish brown	D-625
Limiting ring concolorous or nearly so	35
35. Nodes medium length, constricted both above and below the leaf scar	36
Nodes long, slightly constricted below leaf scar only	37
36. Bud with narrow uniform margin	B-6450
Bud with margin broadest in middle	P. R.-208
37. Leaves erect, rather broad	B-1809
Leaves spreading or declined, medium width	D-117
38. Leaves strictly erect, narrow	P. R.-210
Leaves with the tips declined, broad	39
39. Nodes broad, prominent; stalk not glaucous	P. R.-308
Nodes small, constricted; stalks glaucous	B-208

## RAYADA.

Habit erect or at length recumbent, vigorous. Stalks medium, diameter, longitudinally striped with irregular bands of purplish-red and yellowish-green, usually quite glaucous, color variable.

Internodes variable in length, usually tumid. Straight or little staggered. Furrow evident, medium depth and width.

Nodes more or less oblique, constricted; root band narrow, oblique, widest on side of bud, usually spotted with purple; rudimentary roots in about 3 rows, purplish or the centers purple; limiting ring broad, conspicuous, somewhat elevated; leaf scar glabrous, prominent in front, closely appressed behind; glaucous band usually conspicuous and decidedly constricted.

Buds medium size, subtriangular with rounded base, at first flat but soon plump and often tardily developing. Margin broad, the sides shouldered, ciliate at base and apex.

Sheaths glabrate, glaucous, with a few stiff hairs on medial line; shoulders medium width; throat densely lannate, the vestiture of medium course hairs mainly on shoulders and margin; ligule medium width, entire; collar conspicuous, reaching the midrib, lannate.

Leaves abundant, spreading, the tips declined, medium length and width, long acuminate, serrulate above, margin even below and the base ciliate.

This cane is practically indistinguishable from Crystalina except in color. Taxonomy conforms the view that one is only a color variant of the other.

#### CAVENGERIE.

Habit erect or at length somewhat declined, vigorous. Cane medium height and diameter, dark wine-red, often with faint darker longitudinal stripes.

Internodes medium to long, nearly cylindrical, often somewhat staggered; furrow shallow.

Nodes narrow, somewhat constricted; root band narrow, somewhat constricted; rudimentary roots purplish, in about 3 rows; limiting ring broad, somewhat elevated, yellowish when young, but becoming reddish with age; leaf scar glabrous, often oblique; glaucous band narrow, somewhat constricted.

Buds dark colored, small, ovate, plump, but not developing, obtuse; margin narrow, uniform; base usually appressed ciliate, sometimes glabrate throughout.

Leaf-sheaths reddish-green, usually with faint whitish longitudinal stripes; vestiture dense, of stiff hairs; shoulders narrow; throat with vestiture of rather short hairs; ligule narrow, turned inward, center retuse.

Leaves erect except the tips, abundant, rather short, tapering abruptly, margin ciliate below.

#### D-109.

Habit inclined to recumbent: Stalks long, medium diameter, dark purple, glaucous.

Internodes medium to long, slightly flattened, usually tumid, especially below; furrow shallow or none.

Nodes medium to small, regular, darker than the internodes with age, but lighter when young; root band narrow; rudimentary roots in 2 to 3 rows; leaf scar glabrate; glaucous band somewhat constricted.

Buds oval to ovate, plump, soon expanded; margin narrow, obtuse; apex bearded.

Leaf sheaths subglabrate, very glaucous, usually reddish; shoulders medium, one side often pointed; throat lanate and with soft hairs on shoulders and leaf margin; ligule short, the center somewhat pointed.

Leaves spreading, abundant, dark green, medium width and length, long pointed.

#### D-448.

Habit erect, tall, vigorous. Stalk medium to large diameter, wine color, fading to brownish on long exposure, somewhat glaucous.

Internodes medium to short, cylindrical or often tumid below; furrow none.

Nodes scarcely constricted; root band narrow; rudimentary roots crowded, dark wine color, in 3 or 4 irregular rows but massed toward upper side of band; limiting ring conspicuous, yellowish, sunken; leaf scar glabrous, medium width, appressed behind, glaucous band well marked, not constricted.

Buds large, broader than long; apex rounded, plump, often developing; margin nearly uniform, of medium width, glabrate.

Sheaths glabrate, stained with purple; shoulders medium, not often lobed; throat lannate, also abundant but rather short vestiture especially on shoulders; ligule medium width, broadest at middle, even; collar rather faint, reaching the midrib, glaucous.

Leaves erect or the tips declined, rather broad, bright green, minutely serrulate above, even and ciliate margined below. It arrows freely.

#### JAVA-56<sup>1</sup>

Habit suberect, vigorous. Stalks slender, numerous, brownish purple, not glaucous.

Internodes long, straight, cylindrical; furrow scarcely evident.

Nodes broad, prominent, not constricted; limiting ring narrow, conspicuous, greenish; root band broad; rudimentary roots inconspicuous, purplish in about 3 rows; leaf scar glabrous; glaucous band conspicuous but not constricted.

Buds large, oval, broader than long, obtuse, at first appressed then prominent; margin broad, uniform.

Leaf sheaths glabrate, purplish; throat minutely lannate and with scanty vestiture of hairs; ligule abruptly broadest at center; collar narrow, inconspicuous, not reaching the midrib.

Leaves declined, narrow long acuminate weakly serrulate to base.

#### JAVA-226.

Habit erect, vigorous. Stalks slender, numerous, purplish, with heavy bluish bloom.

Internodes long, cylindrical, straight; furrow scarcely evident.

Nodes tumid, broad; limiting ring elevated, broad, yellow then dark brown; root band broad, palid; rudimentary roots in 3 or 4 rows; leaf scar glabrous, medium width, appressed behind; glaucous band tumid, larger than the internode.

Buds obovate, broad, appressed, then rather prominent; margin wide and shouldered above; apex and base barbed.

Leaf sheaths glabrate, the shoulders unequal; throat lannate but with sparing vestiture of hairs; ligule broad, the margin minutely fimbriate; collar inconspicuous, glaucous.

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<sup>1</sup> Probably an error, as it seems to be the same as Java-36 of the Argentine, which is not the original J-36 of Java.

Leaves erect, the tips declined, narrow, minutely and distinctly serrulate.

### B-3922.

Habit erect or subdeclined, many stalks, vigorous; stalks green, the epidermis checkered, becoming tinged with red when exposed.

Internodes long, cylindrical, almost straight, the upper half lined by cracks in the epidermis; furrow slight but evident.

Nodes prominent, scarcely constricted; root band medium; rudimentary roots white, in about 3 rows; limiting ring obscure; leaf scar conspicuously ciliate; glaucous band conspicuous; scarcely sunken.

Buds broadly triangular, appressed, at length prominent. Margin and obtuse apex with scanty appressed barbs.

Leaf sheaths with scanty and short vestiture, especially above; shoulders broad, equal, not lobed; throat with scanty vestiture but extending into shoulders and leaf margins; ligule prominent, broadest in middle; collar minutely floccose-lanate.

Leaves declined, minutely serrulate above, even and somewhat ciliate below.

### JAVA-324.

Habit erect subdeclined. Stalks numerous, slender, dull greenish, tinted reddish on exposure.

Internodes long, cylindrical or slightly enlarged below, straight; furrow scarcely evident.

Nodes broad, enlarged; limiting ring broad, yellowish, not elevated; root band broad, tumid; rudimentary roots obscure, scarcely evident; leaf scar narrow, appressed behind; glaucous band clearly marked but not constricted.

Buds small, orbicular, becoming hemispheric, glabrous.

Leaf sheaths glabrous; throat lanate but with scanty vestiture of hairs; ligule very broad, minutely fimbriate; collar inconspicuous; glaucous.

Leaves declined, numerous, narrow, hanging long on the stalk, slightly serrulate, the serrations distinct and the points closely appressed.

### CRYSTALINA.

Habit erect to declined or recumbent, vigorous. Stalks medium diameter, greenish or yellowish with shades of pink or lilac when exposed; quite glaucous.

Internodes medium to long, often somewhat tumid, usually straight or not conspicuously staggered; furrow evident, medium depth.

Nodes oblique, constricted; root band narrow, oblique, narrowed behind, slightly constricted; rudimentary roots small, inconspicuous, palid with brownish centers, in about 3 rows; limiting ring conspicuous, yellowish green, elevated; leaf scar glabrous, wide in front, closely appressed behind; glaucous band constricted,

rather narrow, not very conspicuous, often blending with the bloom of the internode.

Buds medium size, subtriangular with rounded base, at first flat but becoming plump at maturity, tardily developing; border wide with the sides shouldered; base and apex appressed-ciliate.

Sheaths glabrate, usually with a few hairs on the central line, quite glaucous; shoulders medium width; throat densely lannate and with medium vestiture of coarse hairs; ligule medium width, entire; collar conspicuous, reaching the midrib, lannate throughout.

Leaves abundant, spreading, the tips declined, medium length and width, flat, long acuminate, bright green, minutely ciliate for two or three inches at base.

### B-376.

Habit erect, then reclined or recumbent. Stalks numerous, medium diameter, color greenish or yellowish, with varying tints of pink or red or lilac when exposed, glaucous.

Internodes of medium length, cylindrical or somewhat tumid, straight or slightly staggered; furrow of medium depth.

Nodes oblique, constricted; limiting ring conspicuous, yellowish green, elevated; root band narrow, oblique, narrowed behind, but little constricted; rudimentary roots inconspicuous, in about 3 rows; leaf scar glabrate, wide in front, appressed behind; glaucous band constricted, not conspicuous, blending with the bloom of the internode.

Buds medium size, subtriangular, with rounded base, plump at maturity but developing tardily; border wide with shouldered sides; base and apex ciliate.

Leaf sheaths glabrate, a few hairs on median line, glaucous; shoulders medium; throat lannate with a medium vestiture of coarse hairs; ligule medium to broad; collar not reaching the midrib, glaucous but not lannate, or sometimes very slightly so, near the margin.

Leaves abundant, spreading, the tips declined, medium green, minutely serrulate above, even below and the base ciliate.

Can scarcely be distinguished from *Crystalina* except by the glabrous collar. In *Crystalina* the collar is lannate to the midrib.

### YELLOW CALEDONIA.

Habit erect, stout, vigorous. Stalks green, yellow when mature, tinted with red where fully exposed; not glaucous.

Internodes long, straight, cylindrical; furrow none, marked with numerous vertical lines or checks in the epidermis.

Nodes short, not constricted; root band narrow; rudimentary roots small, reddish, in about 3 rows; limiting ring broad, conspicuous, greenish or sometimes purplish, even, not elevated; leaf scar

glabrous, narrow, appressed behind; glaucous band conspicuous, not sunken.

Buds small, often purplish, suborbicular, slightly pointed, the point slightly elevated, margin narrow, uniform, base glabrate; margin and apex ciliate, not developing.

Sheaths glaucous, glabrate; shoulders narrow seldom lobed; vestiture of throat scanty, but the shoulders ciliate on margins; ligule medium width, margin even; collar well marked, reaching the midrib, lannate.

Leaves erect except the tips, broad, somewhat plicate, minutely serrulate above, smooth and margin ciliate below.

One of the most vigorous and best marked varieties. The inside of the base of the leaf sheath has a lilac or purplish tint.

#### P. R.-318.

Habit somewhat declined. Stalks heavy, yellowish green, tinted with red on full exposure.

Internodes medium to short, thick, somewhat tumid, slightly staggered; furrow none or very slight.

Nodes broad, subconstricted; root band medium; rudimentary roots whitish, in about 3 rows; limiting ring conspicuous, darker green; leaf scar glabrous, conspicuous, not appressed behind; glaucous band broad, pale, scarcely constricted.

Buds broad, subtriangular, appressed with prominent obtuse apex, margin broad, nearly equal; base and apex minutely barbate.

Leaf sheath subglabrous with inconspicuous vestiture confined to the median line; shoulders uniform or sometimes one of them lobed; throat lannate and with abundant vestiture which reaches the midrib; ligule broad, even; collar conspicuous, brown, lannate.

Leaves erect with tips declined, broad, sharply serrulate to the base.

#### P. R.-230.

Habit erect, vigorous. Stalks numerous, straight, green, pinkish when fully exposed, not glaucous.

Internodes long, cylindrical, medium diameter, straight or slightly staggered; furrows none or very slight below.

Nodes scarcely constricted; root band broad; rudimentary roots large, whitish with brown centers, in about 3 widely spaced rows; limiting ring broad, brown, elevated; scar glabrous, medium width, appressed behind; glaucous band poorly defined, inconspicuous.

Buds large, broadly ovate, soon expanding and prominent, broad-margined; base minutely appressed, ciliate; tip glabrous.

Sheaths at first with moderate whitish vestiture which is soon deciduous, leaving old sheaths glabrate; shoulders narrow, one often acutely lobed; throat lannate, vestiture short, scanty; ligule medium width, subfimbriate; collar broad, reaching the midrib, pale brown, glaucous.

Leaves erect with the tips declined, long, medium width, bright green, minutely serrulate, nearly but not quite to base; margins at base somewhat ciliate.

## B-347.

Habit erect to reclining. Stalks medium to large diameter, yellowish-green with a tinge of red when exposed; somewhat glaucous.

Internodes of medium length, slightly flattened, usually staggered, often marked with irregular light-colored spots.

Nodes medium to large; root band somewhat constricted; rudimentary roots in two to five rows; leaf scar glabrous, prominent on all sides, not appressed behind.

Buds long, ovate or oval, appressed; margin narrow.

Leaf sheath with vestiture of long, soft setae; throat lannate and with a medium vestiture of long, soft hairs.

Leaves suberect, medium width, rather short, the edges usually curled, rather light green.

## B-4596.

Habit erect to reclined. Stalks large, medium length, yellowish green to reddish green, sometimes spotted with reddish brown, glaucous; the epidermis cracked in fine lines.

Internodes medium to long, somewhat flattened, often enlarged below, slightly tumid; furrow medium.

Nodes rather short; root band narrow; rudimentary roots in 2 rows; leaf scar glabrate; glaucous band constricted, conspicuous.

Buds typically large and coarse, broad, obtuse or sometimes pointed, margin wide, with large lobes, occasionally developing and becoming exserted but not sprouting.

Leaf sheaths with vestiture of medium short, fine, stiff setae; shoulders small; ligule medium, rounded or center depressed; throat with vestiture on the shoulders, margins and adjacent leaf surface.

Leaves medium, readily shed, rather broad.

## B-3405.

Habit erect to inclined. Stalks long, medium diameter, reddish green, somewhat glaucous.

Internodes medium length, slightly flattened, tumid on side opposite bud, often somewhat staggered; furrow broad but shallow.

Nodes medium; root band rather broad; rudimentary roots in 2 to 3 rows, leaf scar glabrous, oblique, prominent below the bud, appressed behind; glaucous band slightly constricted.

Buds semi-elliptic to ovate; margin nearly uniform, soon expanded and prominent; sides and apex barbate.

Leaf sheaths with conspicuous vestiture of medium stiff setae; shoulders medium to large; throat with vestiture of long coarse hairs; ligule medium width.

Leaves narrow, light green, long acuminate.

## B-3412.

Habit erect to inclined. Canes numerous, long, slender, green, becoming reddish on exposure.

Internodes medium to long, cylindrical, straight or very slightly staggered; furrow evident.

Nodes medium size, slightly oblique; root band not constricted; rudimentary roots in about 3 rows; leaf scar glabrate; glaucous band constricted, well marked.

Buds large, triangular or broadly ovate, acute; margin of medium width; soon expanding and becoming prominently exserted; the apex bearded.

Leaf sheaths with abundant vestiture of stiff setæ; throat lannate and with a medium vestiture of coarse hairs; ligule narrow, entire; collar glaucous or minutely lannate, not reaching the midrib.

Leaves narrow, long acuminate, medium dark green.

## B-6292.

Habit erect. Stalks long, slender, green then reddish green.

Internodes somewhat inequilateral, tumid on side opposite the bud; furrow shallow.

Nodes medium size, longest on side with bud; leaf scar glabrate; glaucous band constricted, conspicuous.

Buds elliptical with medium uniform margin, usually soon developing with the prominent acute point projecting through the bud scales.

Leaf sheaths with abundant vestiture; shoulders large, usually obtuse, sometimes one-pointed, broad, with vestiture on the shoulders and margins; ligule long, the edge rounded.

Leaves abundant, medium green, narrow, tapering with a long point.

## P. R.-207.

Habit erect, vigorous. Stalk stout, green, faintly tinged with pink on full exposure.

Internodes short, thick, ventricose, nearly straight; furrow, none.

Nodes somewhat constricted; root band broad, rudimentary roots crowded, white, in 4 rows; limiting ring indistinct; leaf scar glabrous, prominent in front, appressed behind; glaucous band broad, conspicuous, constricted.

Buds large, broadly triangular, obtuse, soon prominently developed; base and apex ciliate.

Leaf sheath with scanty deciduous vestiture, soon subglabrate, glaucous; shoulders rather narrow, occasionally acutely lobed; throat densely appressed-lannate, vestiture of long hairs scanty, mostly on margin of lobes; ligule very narrow, edge nearly entire; collar prominent, reaching the midrib, glaucous but scarcely lannate.

Leaves erect, tips declined, broad, abundant, dark green, serrulate to the base.

## P. R.-271.

Habit erect, vigorous. Stalk stout, green, yellow when exposed and at length sometimes pinkish, rather glaucous.

Internodes medium length, cylindrical; furrow none or very faint.

Nodes rather prominent, not constricted; root band narrow; rudimentary roots large, whitish, in 2 to 3 rows; limiting ring broad but indistinct and poorly defined, greenish; leaf scar glabrous, about uniform on all sides; glaucous band not constricted, poorly defined.

Buds medium size, broadly ovate or triangular, soon thick and prominent but not developed, densely ciliate at base and apex.

Sheaths with heavy stiff tawny vestiture; shoulders narrow, seldom lobed; throat with dense but short tawny vestiture; ligule very short, nearly even; collar conspicuous, reaching the midrib, dark brown, lannate.

Leaves erect almost to the tips, broad, dark green, serrulate to the base.

A good vigorous cane, conspicuous for its heavy dark tomentum and glaucous stalks.

## P. R.-292.

Habit at length declined, vigorous. Stalks numerous, green with a heavy bloom, slightly tinted with red when exposed.

Internodes long, cylindrical, straight; furrow none or scarcely evident.

Nodes broad, constricted above the bud; root band broad; rudimentary roots in 3 to 4 rows; limiting ring prominent; leaf scar glabrous, nearly equal behind, not appressed; glaucous band poorly defined, obscured by bloom of the internode.

Buds short, subtriangular, obtuse, flat, with wide, somewhat lobed margin, at length developing and very prominent, often sprouting.

Leaf sheaths with heavy vestiture; shoulders square, not lobed; throat lannate but with scanty vestiture which reaches the midrib and the leaf margin; ligule very narrow, especially at the ends; collar pale brown, reaching the midrib, heavily glaucous.

Leaves erect with tips deflexed, broad, medium color, minutely serrulate above; margin at base ciliate.

## G. C.-1480.

Habit erect, vigorous. Stalk stout, dull green tinted with red, quite glaucous.

Internodes long, subcylindrical, nearly straight; furrow well marked.

Nodes medium width, constricted; limiting ring depressed; root band narrow; rudimentary roots in 2 to 3 rows, often developing in the standing stalk; leaf scar glabrous, prominent, appressed behind; glaucous band poorly defined, blending with the bloom of the internode.

Buds large, ovate-triangular, acute, appressed but soon developed and prominent; margin broadest at base; apex and base barbed.

Leaf sheath with rather scanty vestiture; shoulders seldom lobed, throat with scanty vestiture and scarcely lannate; ligule short, even; collar glabrous.

Leaves erect with tips declined, broad, serrulate to base.

#### G. C.-1486.

Habit erect, vigorous. Stalks stout, green with red-brown tints when exposed, at length quite dark.

Internodes tumid, inequilateral, slightly staggered; furrow evident.

Nodes broad, somewhat constricted; root band broad; rudimentary roots in 3 or 4 rows, often developing on the standing cane; leaf scar glabrous, prominent, appressed behind; glaucous band well marked.

Buds large, triangular, appressed, then prominent; margin broad, inconspicuously lobed, glabrate.

Leaf sheaths with dense vestiture; throat with abundant vestiture extending up the leaf margins; ligule short, even; collar lannate, broad, the lobes brownish, the center pallid.

Leaves broad, crowded, short acuminate, sharply serrulate almost to base, margin ciliate at base.

#### P. R.-309.

Habit erect, vigorous. Canes numerous, large, dull green, dark pink when fully exposed.

Internodes rather long, medium diameter, slightly larger below, nearly straight; furrow none.

Nodes somewhat constricted below, medium width; root band medium; rudimentary roots large, reddish yellow, not conspicuous, in about 3 rows; limiting ring broad, elevated, greenish; leaf scar glabrous, not conspicuous, wider in front; glaucous band medium width, not conspicuous, constricted, forming the narrowest point in the stalk.

Buds medium to small, hemispheric with wide lateral margins, red dish, prominent but not developed; apex retuse, glabrous, the broad-shouldered margins ciliate, the base glabrate.

Leaf sheaths with an abundant vestiture of long, soft, whitish hairs; shoulders narrow, not lobed; throat with scanty vestiture; ligule narrow, entire; collar narrow, pale brown, scarcely reaching the midrib, lannate.

Leaves erect except the tips, broad, abundant, very minutely serrulate, the margin at base nearly even.

#### D-433.

Habit erect or at length declined, very vigorous. Canes numerous, medium diameter, gray-green, with some brownish or pinkish shades, densely glaucous.

Internodes medium length and thickness, cylindrical or slightly tumid below the middle; furrow none.

Nodes slightly constricted, narrow; root band constricted, narrow; rudimentary roots large but indistinct, whitish, crowded, in about 3 rows; leaf scar glabrous, short, appressed on all sides; glaucous band not constricted, poorly defined, blending with the heavy bloom of the internode.

Buds small, flat, closely appressed, suborbicular but pointed, not developing; apex densely ciliate with heavy tufts of hairs; base subglabrate.

Leaf sheaths with heavy vestiture of stiff hairs and densely glaucous; shoulders narrow, not lobed; throat with moderate vestiture, mostly on shoulders and margin; ligule narrow, retuse, edge ciliate; collar broad but poorly defined, reaching the midrib, glaucous.

Leaves erect, the tips declined, medium width, dark green, minutely serrulate almost to the ciliate base.

#### P. R.-209.

Habit erect, vigorous. Stalks numerous, green with a tinge, of pink, not glaucous.

Internodes short, stout, cylindrical, staggered; furrow none.

Nodes scarcely constricted, broad; root band broad; rudimentary roots large, yellowish, in about 3 rows; limiting ring broad, conspicuous, elevated, greenish; leaf scar glabrous, conspicuous, broad in front, appressed behind; glaucous band broad, well marked.

Buds large, hemispheric but somewhat pointed, prominent, soon somewhat developed; margin broad, shouldered; base and apex ciliate.

Sheaths with medium vestiture of stiff whitish hairs; shoulders broad, often lobed; throat with medium vestiture; ligule medium width, margin even; collar broad, dark, conspicuous, reaching the midrib, lannate.

Leaves erect except the tips, very broad, abundant, dark green, marginal serrations very minute, the lower half almost even.

#### P. R.-270.

Habit declined at base, vigorous. Stalks numerous, green becoming pink when exposed, not glaucous.

Internodes medium to short, medium diameter, cylindrical, slightly staggered; furrow none.

Nodes scarcely constricted; root band broad; rudimentary roots crowded, rather prominent, 3 or 4 rows; limiting ring indistinct; leaf scar glabrous, equally prominent on all sides, narrow; glaucous band rather broad, well marked, slightly constricted.

Buds small, reddish, hemispheric, margin rather broad, uniform, subglabrous.

Sheaths with an abundant vestiture of short tawny hairs; shoulders broad, often lobed; throat with abundant vestiture; ligule very short, margin nearly even; collar conspicuous, nearly reaching the midrib, lannate.

Leaves erect, with the tips declined, often plicate and inrolled, medium width, serrulate to the base.

### G. C.-701.

Habit erect or subdeclined. Stalks numerous, heavy, pale green.

Internodes medium, slightly constricted; root band narrow, rudimentary roots with brownish centers, in 2 or 3 rows; limiting ring conspicuous, elevated; leaf scar short, heavily ciliate with pallid hairs; glaucous band narrow, somewhat constricted.

Buds abovate, the margin shouldered above, at first flat, soon developing and prominent, often sprouting; apex and base minutely barbed.

Leaf sheaths with heavy vestiture; shoulders both lobed; throat lannate but with scanty vestiture; ligule medium width, nearly even; collar lannate.

Leaves declined, broad, serrulate throughout.

### KAVANGIRE.

Habit subinclined, very vigorous. Stalks slender, very numerous, green, glaucous thruout.

Internodes long, cylindrical; furrow none.

Nodes broad, not constricted; root band broad; rudimentary roots scarcely showing; leaf scar glabrate, short; glaucous band not defined, blending with the bloom of the internode.

Buds broadly oval, narrowed below, obtuse, glabrous, plump but closely appressed.

Leaf sheaths glabrate; shoulders narrow; throat subglabrous, the vestiture reduced to a few short hairs on the shoulders, ligule abruptly widened at the center.

Leaves numerous, hanging long on the stalk, declined, narrow, long acuminate, minutely serrulated to the base.

### B-109.

Habit erect to inclined. Stalks medium to large diameter, yellowish green, not reddening.

Internodes medium length, cylindrical, straight or very slightly staggered; furrow very slight or none.

Nodes medium size, not constricted, limiting ring prominent; root band slightly enlarged; rudimentary roots in 2 to 3 rows; leaf scar glabrate; glaucous band well marked but not constricted.

Buds variable, short, triangular; margin narrow, uniform.

Leaf sheaths glabrate; shoulders narrow, often long pointed; throat with vestiture of coarse hairs; ligule medium to short, entire.

Leaves abundant, medium broad, dark green.

## P. R.-202.

Habit erect or the base reclined, very vigorous. Stalks heavy, thick, green, conspicuously glaucous.

Internodes long, large diameter, cylindrical, straight, not staggered; furrow none or very slight.

Nodes scarcely constricted; root band medium width; rudimentary roots inconspicuous, in 2 or 3 rows; limiting ring broad and conspicuous, yellowish brown, slightly elevated; leaf scar glabrous, narrow appressed behind; glaucous band medium width, not conspicuous, blending with the bloom of the internode.

Buds large, hemispheric, the point appressed, prominent but not developing, margin narrow, base and apex appressed, ciliate.

Sheathes glabrate, glaucous, at first with sparing white vestiture, which is soon deciduous; shoulders broad, usually not lobed; throat narrowly lannate, vestiture short and scanty; ligule short, margin nearly even; collar narrow, not reaching midrib, brown, minutely lannate.

Leaves erect except the extreme tip, rather short, broad, inrolled, minutely serrulate almost to base, the serrations ending in hair-like awns below.

## G. C.-493.

Habit declined, vigorous. Stalks heavy, yellowish green.

Internodes long, cylindrical, straight; furrow none or scarcely evident.

Nodes broad, not constricted; root band broad; rudimentary roots brownish, in about 3 rows; limiting ring broad, elevated; leaf scar glabrous, not prominent, appressed behind; glaucous band broad but poorly defined.

Buds subhemispheric, reddish, margins broad, equal, base, margin and apex ciliate.

Leaf sheaths glabrate; throat minutely lannate, vestiture reduced to a few short hairs; shoulders with short lobes; ligule narrow, even; collar minutely lannate.

Leaves declined, narrow, minutely serrulate above, even below.

## P. R.-317.

Habit subdeclined, vigorous. Stalks numerous, light green, not glaucous.

Internodes long, cylindrical, somewhat staggered; furrow slight or none.

Nodes prominent, oblique, scarcely constricted; root band rather broad; rudimentary roots white, in about 4 rows; limiting ring obscure but somewhat elevated; leaf scar glabrous, heavy and prominent below the bud appressed behind; glaucous band conspicuous.

Buds ovate to narrowly ovate, flat, appressed; margin narrow, uniform, glabrous.

Leaf sheaths with dense vestiture; shoulders equal or sometimes one with small lobe; throat lannate and with medium vestiture of longer hairs; ligule prominent, broadest in the middle, even; collar conspicuous.

Leaves with the tips declined, medium width and color, minutely serrulate above, even below.

#### P. R.-219.

Habit often declined at base, medium vigor. Stalks of medium diameter, green, not conspicuously glaucous.

Internodes rather short, cylindrical, not staggered; furrow none.

Nodes slightly constricted above; root band medium width; rudimentary roots inconspicuous, whitish, in about 3 rows, often developing under the leaf sheaths; limiting ring inconspicuous, greenish; glaucous band poorly defined.

Buds medium to small, broadly oval, obtuse, rather prominent but the point appressed, not developing; margin narrow, uniform; base and apex ciliate.

Leaf sheaths with heavy vestiture of stiff hairs at length partly deciduous, somewhat glaucous; shoulders rather broad, usually not lobed; throat with heavy vestiture; ligule medium width, nearly even; collar narrow, reaching the midrib, minutely lannate.

Leaves erect except the tips, rather narrow, medium to short, often inrolled and subuplicate, serrulate almost to base.

#### P. R.-260.

Habit erect, vigorous. Stalk green with heavy bloom.

Internodes rather long, cylindrical, straight or slightly staggered, furrow shallow but well marked.

Nodes scarcely constricted; root band and rudimentary roots indistinct; limiting ring elevated; leaf scar prominent, narrower behind but not appressed; glaucous band obscured by heavy glaucous coating of the internode.

Buds long, narrowly ovate or sublanciolate, with a long acute point, soon developing and becoming prominent, bearded at the base and apex.

Leaf sheath with heavy vestiture; shoulders with long pointed lobe; vestiture of throat abundant but not reaching the midrib, lannate.

Leaves erect, the tips slightly declined, medium width, closely and finely serrulate throughout but less so below.

#### OTAHEITE.

Habit erect, often becoming declined. Stalk greenish yellow.

Internodes medium to long, often tumid, sometimes flattened, somewhat staggered; furrow medium.

Nodes medium, longest at bud side; root band not constricted; rudimentary roots in 2 or 3 rows; leaf scar glabrous, oblique, prominent below the bud; glaucous band constricted, well marked.

Buds sub-elliptic to ovate; margin narrow, uniform; sides and apex bearded.

Leaf sheaths with heavy vestiture; shoulders large, often acutely lobed; throat with moderate vestiture of soft hairs mostly on the shoulders; ligule medium length, retuse.

Leaves erect except the tip, medium width, long acuminate.

#### D-625.

Habit erect. Stalks long and large, light green to yellow.

Internodes long, cylindrical, often somewhat staggered; furrow broad but shallow.

Nodes long and prominent; limiting ring broad, elevated, reddish brown; root band broad, as large or larger in diameter than the internode; rudimentary roots distinct, in 2 to 3 rows; leaf scar glabrate; glaucous band shallow, but little constricted.

Buds large, uniform, triangular, plump; margin narrow, uniform; apex and sides bearded.

Leaf sheaths with abundant vestiture of soft setæ; shoulders small; throat lannate and with vestiture of fine hairs on shoulders and behind ligule; ligule medium length; rounded.

Leaves suberect, medium green, tapering abruptly to a fine point.

#### B-6450.

Habit reclining. Stalks medium length and diameter, green, yellowing on maturity but with no reddish tints, often minutely checked when mature, somewhat glaucous.

Internodes medium length, somewhat tumid, more or less staggered; furrow broad but shallow.

Nodes medium length, constricted; root band rather broad; rudimentary roots white, distinct, in 2 to 4 rows; leaf scar glabrate; glaucous band strongly constricted.

Buds medium size triangular-ovate, flat, margin narrow, uniform, hirsute at base.

Leaf sheaths with rather fine, soft vestiture; shoulders broad, often pointed; throat with soft vestiture; ligule medium.

Leaves abundant, medium green, tips declined.

#### P. R.-208.

Habit semi-erect, vigorous. Stalks stout, green.

Internodes of medium length, nearly cylindrical but enlarged below on side of bud, somewhat staggered; furrow well marked.

Nodes constricted; root band constricted; rudimentary roots in about 3 rows; limiting ring narrow, sunken; leaf scar glabrous, appressed behind; glaucous band constricted, well marked.

Buds broadly oval or subtriangular, appressed, margin broadest in middle but scarcely shouldered, the apex ciliate.

Leaf sheaths with heavy vestiture; shoulders narrow; throat with

abundant vestiture reaching the midrib, also appressed lannate; collar glaucous, brown, conspicuous, reaching the midrib.  
 Leaves broad, suberect, the tips declined, minutely serrulate, the serrations ending in weak, appressed tips that become longer and hair-like below.

### B-1809.

Habit erect. Canes long, large, green, becoming yellowish.  
 Internodes long, flattened, usually largest below; furrow broad and rather deep.  
 Nodes large, conspicuous: limiting ring broad and prominent: root band prominent, enlarged above to meet the prominent limiting ring; rudimentary roots in 2 to 3 rows; leaf scar glabrate; glaucous band somewhat constricted.  
 Buds large, triangular but longer than broad, pointed; margin narrow, uniform or with small marginal lobes, bearded.  
 Leaf sheaths glaucous and with medium stiff vestiture: shoulders small; ligule medium length, the center depressed: throat with medium vestiture.  
 Leaves abundant, erect, medium green, rather broad.

### D-117.

Habit erect. Stalks long, medium diameter, light green to yellowish green.  
 Internodes medium to long, slightly flattened, swollen at base on the bud side, straight behind; furrow shallow but broad.  
 Nodes large, somewhat oblique: limiting ring prominent: root band broadest on side of bud: rudimentary roots crowded in 3 or 4 rows; leaf scar glabrate prominent below the bud, appressed behind; glaucous band medium.  
 Buds broadly ovate or triangular, acute; margin medium to narrow, uniform, not shouldered; apex and sides barbellate, sometimes expanding but not prominent.  
 Leaf sheaths with sparing vestiture of soft setae: shoulders often pointed: throat lannate, and with long hairs on the shoulders; ligule short, rounded or center depressed.  
 Leaves spreading, the tips declined, medium green, medium length and width.

### P. R.-210.

Habit erect, strict, vigorous. Stalks dark green.  
 Internodes medium to short, cylindrical, no furrow, a zone conspicuously discolored by minute checks or cracks below the node.  
 Nodes prominent, often oblique: root band narrow, clearly marked; rudimentary roots in about 3 rows; leaf scar glabrous, short, appressed behind; glaucous band clearly marked.  
 Buds prominent, sub-hemispheric, tinted reddish brown, the point soon developing; margin broadly lobed; sides and tip appressed, ciliate.

Leaf sheaths with moderate vestiture below, subglaucous above; shoulders usually with one long-pointed glabrous lobe; throat with short scanty vestiture; ligule narrow, even; collar brown, reaching the midrib, glabrous.

Leaves narrow, dark green, strictly erect, acuminate; margin sparingly serrulate above with short, hooked teeth, even toward the base.

#### P. R.-308.

Habit erect. Stalk stout, green, not glaucous.

Internodes short, stout, enlarged below, staggered; furrow shallow. Nodes broad, rather prominent; root band swollen; rudimentary roots large but not conspicuous, in about 3 rows; limiting ring broad, conspicuously elevated; leaf scar glabrous, medium width, equal on all sides; glaucous band conspicuous, somewhat constricted.

Buds small, subhemispheric, margin narrow but shouldered, giving obovate effect, glabrous.

Leaf sheaths with moderate vestiture of long soft hairs; shoulders narrow, usually not lobed; throat with very scanty vestiture, almost glabrate; ligule very narrow, entire; collar narrow but reaching the midrib, dark brown, lannate.

Leaves erect with tips declined, very broad, abundant, sharply serrulate to the base.

#### B-208.

Habit erect, then inclined. Stalks medium length, large diameter, green, somewhat glaucous, no tints of red.

Internodes short, tumid; furrow very shallow.

Nodes small, constricted; root band slightly constricted; rudimentary roots in 2 to 3 rows; leaf scar glabrate; glaucous band narrow, strongly constricted.

Buds large, subhemispheric, soon developed and prominent; margin broadest across the top.

Leaf sheaths with long stiff vestiture; shoulders small; ligule medium length with center slightly depressed; throat with abundant vestiture of soft hairs.

Leaves not abundant, short, rather broad, dark green, tapering to an abrupt point.

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Secciones de Hojas Matizadas.

Variedad Cristalina

Sections of Mottled Leaves.

Variety Crystalline.